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ABSTRACT

This study examined the effects of the type of adjunct questions (use-a-generality, remember-a-generality, and remember-an-instance) and the position of these questions either before the relevant text passage (pre-questions) or after it (post-questions) on the three corresponding performance levels of learning. The subjects were 74 eighth-grade students at a suburban school in Syracuse, New York, and the materials for the learning task consisted of an approximately 450-word passage selected from a social studies textbook for this grade level. Six different treatment groups were used, with each group receiving adjunct questions which varied as to performance level and placement of the questions. The results were analyzed separately for each level of performance as well as for the total test score. None of the effects reached significance for any of the subtests. These results suggest that, in order to optimize learning, the position of the adjunct questions must be taken into account as well as the type of question to be used. An 18-item reference list is provided. (RP)

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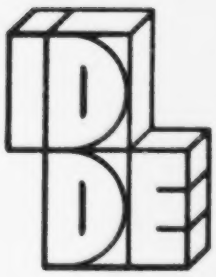

INSTRUCTIONAL DESIGN, DEVELOPMENT, AND EVALUATION

WORKING PAPERS

TYPE AND POSITION OF ADJUNCT QUESTIONS: THEIR EFFECTS ON MEMORY AND APPLICATION

by

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ABSTRACT

Seventy-four male and female eighth-grade students were presented with a 450-word passage from a social studies textbook. Three types of adjunct questions were placed either before or after the relevant passage. They were: 1) Remember-an-instance (RI) questions requiring students to recall a specific information, 2) remember-a-generality (RG) questions requiring students to recall the statement of a general idea, such as a concept, principle, or procedure; and 3) use-a-generality (UG) questions requiring students to apply the generality to new situations they have not seen before. On the nine short-answer posttest questions, which were comprised of these three types of learning (RI, RG, UG), no significant main effects were found. Only a significant interaction between type and position of adjunct questions was found. This interaction indicates that use-a-generalitly adjunct questions led to superior performance when they were placed after the relevant passage, whereas the remember-an-instance adjunct questions led to superior performance, when they were placed before the relevant passage. This result suggests that during instruction not only the type of adjunct question should be taken into account, but also the position of that type of question.

Two of the aims of instruction are to promote thinking and improve students' learning, and asking questions during learning is one way to accomplish these ends (Rothkopf, 1966; Rothkopf and Bisbicos, 1967; Frase, 1967, 1968; Yost, Avila and Vexler, 1977). Researchers have studied adjunct questions in terms of type and position. Types of adjunct questions have primarily been memorization-level questions, which ask about specific previous information, and application-level questions, which require applying the previous information to new situations.

Memorization-level questions can be further classified as two types: recognition questions, such as a multiple-choice question about specific information (e.g., Which of the following is the capital of the U.S.A.?) contained within the instructional material; and recall questions, such as a constructed-response or fill-in-the-blank question about such information (e.g., What is the captial of the U.S.A.?). Corresponding to these two types, application-level questions can require the learner either to identify a new example, such as a multiple-choice question about an instance that the student have not seen before (e.g., Which of the following pictures are pictures of mammals?); or to produce a new example, such as a constructed response question that requires the students to create a prediction or a solution to a problem that they have not seen before (e.g., "solve this problem by using a principle you have just learned").

Position of adjunct questons is usually classified in terms of whether the questions are inserted before or after the instructional material (or both before and after).

Type of Adjunct Questions

With respect to type of adjunct questions, some research studies have found that questions which require students to apply the principles or concepts described in a passage can give more effective learning than questions which require students to remember this kind of content. For example, Watts and Anderson (1971) found that subjects who received questions requiring them to apply principles just covered to new examples performed significantly better on the posttest (which contained both recall and application questions) than did subjects who received adjunct questions requiring them to recall previous examples. Felker and Dapra (1975) also found that subjects who received application-level adjunct questions requiring them to identify new examples of either concepts or principles performed significantly better on an application-level posttest than did either the group which received questions requiring them to recall the text verbatim or the control group which received no adjunct questions during instruction. Felker and Dapra also found that application-level adjunct questions resulted in better problem solving than did verbatim questions (asking students to recall exact text words).

By using another kind of criterion, Rickards and DiVesta (1974) found that students who received questions on meaningful learning which required subsumption or organization of facts under given ideas, performed better than students who received questions requiring them to recall specific facts or ideas (rote learning of ideas and facts) on a posttest containing this kind of learning.

However, some other studies have failed to sustain these results. Andre et al. (1980) found that out of seven studies which investigated the effects of adjunct questions on application and recall levels, five studies found no significant differences between factual questions and application questions on posttests including these two kinds of learning. The other two studies found a superiority for factual adjunct questions. Hence, type of adjunct questions seems to have had an inconsistent main effect on learning. This inconsistency could possibly be resolved by looking at the position of adjunct questions.

Position of Adjunct Questions

With respect to position of adjunct questions Rothkopf (1966) and Rothkopf and Bisbico (1967) found that questions which were presented after the relevant text passage had apparently both an intentional (direct) learning effect in which the content learned was addressed by adjunct questions during instruction, and an incidental (indirect) learning effect in which the content learned was not addressed by adjunct questions during instruction.

Frase (1967, 1968) also found that students who received adjunct questions after the relevant passage performed better on the posttest containing both intentional questions and incidental questions than did students who received adjunct questions before reading the relevant passage. Sagaria and DiVesta (1978) supported Frase's results. In contrast, Rickards (1976) found that conceptual prequestions produced higher recall than conceptual postquestions on a posttest containing conceptual questions.

Hence, position of adjunct questions also has had an inconsistent main effect on learning. The inconsistent effects of both type and position of adjunct questions could possibly be resolved by considering the interaction between type and position of adjunct questions. In other words, one type of adjunct questions may be more effective than the other type when the questions are presented after the reading passage but not when they are presented before it, and vice versa.

Interaction between Type and Position of Questions

Rickards (1976) found that type and position of adjunct questions interacted to a significant degree: only recall-level

postquestions (which required students to recall specific, previous information) were superior to the control group on the immediate, free-recall test, whereas on the delayed, free-recall test, only conceptual prequestions (which require abstraction of the material) were superior to the control group.

Andre et al. (1980) also found (in their experiment number 1) a significant interaction between type and position of adjunct questions. When questions came after the relevant pages, application questions led to superior performance, but when questions came before the relevant pages, name (or memory) questions led to superior performance. In contrast, they also found opposite results in experiment number 2: they found an interaction which indicated basically that performance was better on name questions when those questions came after the relevant text than when they preceded it, while the effects of application questions did not differ with their position. They also found in their experiment number 3 that performance on application questions was better when those questions were inserted before the text, whereas performance on name questions was better when they were inserted after the text.

Levels of Learning

As can be seen from the above studies on the interaction of type and position of adjunct questions, the results are still inconsistent. But previous studies have used application and recall measures as dependent variables without distinguishing between different levels of remembrance. It seems possible that the effects of type and position of adjunct questions might vary depending on the level of learning. Hence, it was decided that this study should investigate different levels of learning (as distinct dependent variables), as well as the interaction between the type and the position of adjunct questions.

Several taxonomies of levels of learning have been developed (see e.g., Bloom, 1956; Gagne, 1979; Guilford, 1959; Hunkins, 1972; and Merrill, in press). Of these, we suspect that Merrill's taxonomy of levels of learning may be the most useful one for prescribing the type and position of adjunct questions, primarily because of its identification of different levels of rememberance.

Merrill (in press) distinguishes among four major levels of cognitive processing and hence four major levels of learning: find-a-generality (FG), use-a-generality (UG), remember-a-generality (RG), and remember-an-instance (RI). The find-a-generality (FG) level is that performance level which requires the learner to derive or invent a new rule (e.g., to derive a new principle from a set of examples). The use-a-generality (UG) level requires the learner to apply some rule to a specific case that he or she did not encounter in the instruction (e.g., "Classify this new cell, which was not

presented before, as an animal cell or a plant cell"). The remember-a-generality (RG) level requires the learner to search his or her memory in order to recall or recognize a rule (e.g., "What is the definition of animal cell?"). Finally, the remember-an-instance (RI) level requires the learner to recall or recognize some specific information (e.g., "What is the name of the apparatus that we just discussed?").

Because of its lack of relevance to the level of learning of most prose materials, the find level was not investigated in the present study. Using Merrill's taxonomy of performace levels to clarify the nature of adjunct questions, this study investigated three major questions related to the effects of adjunct questions:

1. What type of adjunct questions (UG, RG, RI) most facilitates learning?
2. What position of adjunct questions (pre or post questions) most facilitates learning?
3. Is there an interaction between type and position of adjunct questions?

Hypotheses

The main purpose of this study was to examine the effects of type of adjunct questions (use-a-generality, remember-a-generality, and remember-an-instance) and the position of adjunct questions (pre and post questions) on the three performance levels of learning. Therefore the following hypotheses were investigated:

1. Type of questions - performance level

a. Remember-an-instance adjunct questions will facilitate learning on the remember-an-instance level more than on the remember-a-generality or the use-a-generality level:
RI --> RI > RG > UG.

b. Remember-a-generality adjunct questions will facilitate learning on the remember-a-generality level more than on the use-a-generality or remember-an-instance level:
RG --> RG > UG > RI.

c. Use-a-generality adjunct questions will facilitate learning on the use-a-generality level more than on the remember-a-generality or remember-an-instance level:
UG --> UG > RG > RI.

2. Position of questions

a. Pre questions will facilitate learning on the remember-an-instance and remember-a-generality levels more than on the use-a-generality level:
Pre --> RI = RG > UG

b. Post questions will facilitate learning on the use-a-generality level more than on the remember-a-generality or remember-an-instance level:
Post --> UG > RG = RI

3. Type and position of questions (Interaction)

a. Remember level questions will facilite learning more when used as pre questions than as post questions, whereas application level questions will facilitate learning more

when used as post questions than as pre questions:
pre RI --> best on RI outcome
pre RG --> best on RG outcome
post UG --> best UG outcome

Method

Subjects

The subjects were 74 eighth grade males and females at a suburban school in Syracuse, New York. They were primarily from middle-class homes. They were informed that the learning task was a part of their regular course requirements. The students were assigned randomly to six treatment groups.

Design

The design of this study was a two- way analysis of variance factorial design (3x2). The factors were (1) type of adjunct questions (RI, RG, UG) and (2) position of adjunct questions (pre and post). Post hoc multiple comparisons were used for all significant F's (at p=.05) by using Duncan's Multiple Range Test on the Statistical Analysis System (SAS).

Materials

The materials for the learning task consisted of approximately a 450-word passage which was selected from a social studies textbook for eighth graders. The passage discussed the idea of Pan-Africa (a united Africa for all countries of the continent), and it gave some generalities (e.g., Nkrumah's tribe named their children for their birthday) and some examples (e.g., Saturday is the meaning of Nkrumah's name). There were three different sets of adjunct questions (UG, RG, and RI), and they were inserted either before or after the passage. Three short-answer adjunct questions were written on the use-a-generality level. These questions were inserted either before or after the passage for the respective treatments (UG pre questions and UG post questions). Such a question, for example, might ask: If you were born in Nkrumah's tribe on Tuesday, what would your name be?

Three other short-answer adjunct questions were written on the remember-a-generality level and were inserted either before or after the passage for the respective treatments (RG pre questions and RG post questions). Such a question might ask, for example: How did Nkrumah's tribe name their children?

The last three short-answer adjunct questions were written on the remember-an-instance level and were inserted either before or after the passage for the respective treatments (RI pre questions and RI post questions). For example, such a question might ask: Does Nkrumah's name mean "Saturday"?

Measures

The nine short-answer posttest questions were written on the three performance levels (UG, RG, and RI). The use-a-generality test required students to apply the generality to a new situation. The remember-a-generality test required students to recall the definition of the generality. And the remember-an-instance test required students to recall a specific instance of the generality. The adjunct questions on the remember level (either RG or RI) were repeated in the posttest, whereas the questions on the application level (UG) were different from the UG adjunct questions which had been used during the instruction.

Treatments

Six different treatment groups were used, with each group receiving adjunct questions which varied as to performance level (RI, RG, UG) and placement of the adjunct questions (pre or post). Thus, the treatments can be represented as:

Pre question Groups	Post question Groups
1. Remember an instance	4. Remember an instance
2. Remember a generality	5. Remember a generality
3. Use a generality	6. Use a generality

In the pre question treatments, the students were instructed to answer the questions before turning ahead to the passage. They were then directed to read the passage once without turning back to the questions, and to raise their hands when they had finished reading. They were then given the posttest. In the post question treatments, the students were told to read the passage once, and then go to the next page. The students were then instructed to answer the questions without turning back to the passage, and to raise their hands when they had finished answering the questions. They were then given the posttest.

Procedure

The experiment took place during three consecutive class periods (45 minutes each) in the morning at the West Hill High School, a suburban school in Syracuse, New York. The booklets, which contained the passage and the adjunct questions, were randomly passed out to students within each class. Then the students were instructed by the experimenter to read the directions at the beginning of their booklets. The directions explained that the purpose of the study was to investigate how students learned from written materials and how they used questions they encountered as they read. The directions also explained that the aim of the study was to enhance their learning by using good questions and inserting them in suitable positions in the passage. Finally, the students were told that once they turned a page, they would not be allowed to look back

at any previous pages.

The students read the passage and answered the adjunct questions at their own pace. At the end of their booklets, they were instructed to raise their hands for the posttest. The booklets had been numbered according to treatment groups. As each posttest was handed out, it was given the same number as the treatment booklet, so as to keep track of which test belonged to which treatment group. When the students completed their test, they were instructed to quietly read a book until the period was over. The students were given 45 minutes to complete the passage, answer the adjunct questions, and answering the posttest questions. Most of the students finished all of the above within 35 minutes, and all finished within the 45 minute period.

Results

The test was comprised of items on three different levels of performance: remember-an-instance, remember-a-generality, and use-a-generality. The results were analyzed separately for each level of performance, and an analysis was also performed for the total test score. Tables 1, 2, and 3 summarize the results for the UG, the RG, and the RI subtests, respectively. None of the effects reached significance for any of these subtests. Hence, these results failed to support hypotheses 1 and 2.

Insert Tables 1, 2, and 3 about here

Table 4 summarizes the results for the total test scores. Only the interaction effect proved significant, $F(2,58) = 3.14$, $p=.05$. Figure 1 illustrates this interaction. UG questions led to superior performance when they came after the relevant passage, whereas RI questions led to superior performance when they came before the relevant passage. However, there were no significant main effects on either type of adjunct questions, $F(2,58) = .57$, $p=.566$, or position of adjunct questions, $F(1,58) = .48$, $p=.327$. This result supported the hypothesis 3, but failed to support hypotheses 1 and 2.

Discussion

The results on each subtest (UG, RG, and RI) failed to support any of the hypotheses. This supports the results that Andre et al. (1980) found in five of their eight studies: that different types of adjunct questions have no localized effects on either application or remember level learning. It also indicates that different positions of adjunct questions have no localized effects on either application or remember level learning.

On the other hand, the significant interaction between the type and position of adjunct questions on the total test supports hypothesis 3. It indicates that pre questions are more effective when they are on the remember level (RI or RG), whereas the post questions are more effective when they are on the application level (UG). This result supports the same finding of experiment 1 by Andre et al. (1980).

Pre questions serve as a method of arousing "selective attention." Hence, while reading the pasage, the learner will focus attention on those thoughts and ideas which are related directly to the pre questions and will neglect the ideas and thoughts which are not related to the pre questions. The learner probably expects the following posttest to be quite similar to the content of pre questions (Rothkopf and Bisbicos, 1967). This explanation is true in the case of RI and RG pre questions. However, UG questions are so different from the content of the passage that the selective attention function of pre questions is greatly reduced. Our results concur with this explanation because they show that pre questions were more effective when they were at the RI and RG levels than when they were at the UG level (see Figure 1).

Because post questions come after the passage, they cannot serve a "selective attention" function; rather they can only serve as to "refresh the learner's memory." RI and RG post questions serve to refresh memory in the frame of the passage -- that is, they reinforce remember-level learning. UG post questions, on the other hand, ask about something quite different than the information presented in the passage. These questions, therefore, probably serve to refresh the learner's memory in a way that encourages the learner to go beyond the information in the passage by generalizing from the passage to new situations (Andre and Womack, 1978). Our results concur with this explanation and show that post questions were more effective when they were at the UG level rather than at the RG or RI level (see Figure 1).

The most surprising finding of this study was the lack of significance on the main effects for each of the three subtests. This study's inability to find such significance does not mean that such significance does not exists. In fact, the small number of test items (3) on each subtest would make it very difficult for those subtests to detect real differences. This conclusion suggests that this study should be replicated using more test items.

In conclusion, the results of this study suggest that, to optimize learning, not only the type of adjunct question should be taken into account in designing instruction, but also that inserting those questions in a suitable position is also important.

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Effect	$\bar{X}$, (S.D) . N						F	df	P
Type	UG		RG		RT		.19	(2,58)	.83
	2.4,(.88),20		2.39,(.50),23		2.40 (.64),21				
Position	Before			After			.46	(1,58)	.50
	2.30, (.73), 33			2.42, (.62), 31					
Type X Position	UG	RG	RI	UG	RG	RI	1.90	(2,58)	.16
	2.10 (.21) 10	2.42 (.20) 12	2.36 (.20) 11	2.70 (.21) 10	2.36 (.20) 11	2.20 (.21) 10			

Table 1. Means . standard deviations and number of students for the UG test.

Effect	$\bar{X}$. (S.D) . N						F	df	P
Type	UG		RG		RI				
	2.1, (1.02), 20		2.26, (.69), 23		2.29, (.78), 21		.36	(2,58)	.74
Position	Before			After					
	2.18, (.84), 33			2.26, (.82), 31			.15	(1,58)	.70
Type X Position	UG	RG	RI	UG	RG	RI			
	1.80 (.26) 10	2.25 (.24) 12	2.45 (.25) 11	2.4 (.26) 10	2.27 (.25) 11	2.10 (.26) 10	1.71	(2,58)	.19

Table 2. Means, standard deviation, and number of students for RG test.

Effect	$\bar{X}$, (S D), N						F	df	P
Type	UG		RG		RI		1.4	(2,58)	.34
	1.8, (.83), 20		2.0, (.80), 23		1.62, (.92), 21				
Position	Before			After			.68	(1,58)	.41
	1.73, (.84), 33			1.90, (87), 31					
Type X Position	UG	RG	RI	UG	RG	RI	.87	(2.58)	.42
	1.60 (.27) 10	1.83 (.25) 12	1.73 (.26) 11	2.0 (.27) 11	2.18 (.26) 11	1.50 (.27) 10			

Table 3. Means, standard deviation, and number of students for RI test.

Effect	$\bar{X}$, (S.D) , N						F	df	P
Type	UG		RG		RI		.57	(2,58)	.57
	6.30, (1.87),20		6.65, (1.40),23		6.19, (1.36),21				
Position	Before			After			.98	(1,58)	.33
	6.21, (1.50), 33			6.58, (1.59), 31					
Type X Position	UG	RG	RI	UG	RG	RI	3.14	(2,58)	.05 *
	5.50 (.47) 10	6.50 (.43) 12	6.55 (.45) 11	7.10 (.47) 10	6.82 (.45) 11	5.80 (.47) 10			

Table 4. Means, standard deviation, and number of students for Total test.

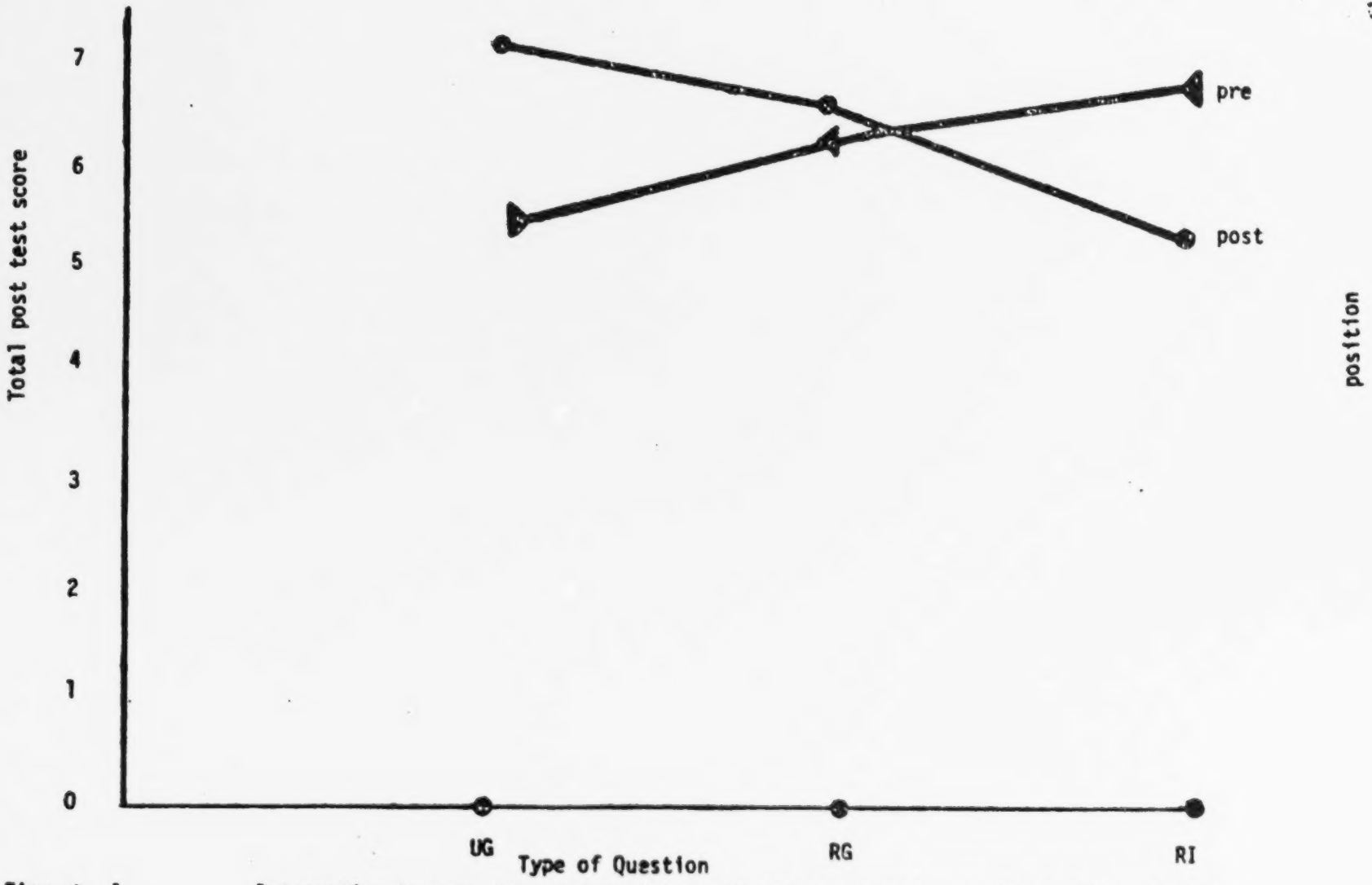

Figure 1. Interaction between type and positions of adjunct question on the total post test.